REMARKS/ARGUMENTS

This paper is responsive to the Office Action mailed July 23, 2004. Presently, all claims 1-20 stand rejected. Reexamination and reconsideration of this application is respectfully requested in view of the amendments to the claims, and the remarks provided hereinbelow.

I. The §112 rejections.

Claims 1, 6, 11 and 16 were rejected under 35 U.S.C. §112, first paragraph, as being non-enabling for the inclusion of hydrocarbons other than those listed in the specification and the dependent claims. Claims 1, 6, 11 and 16 were also rejected under 35 U.S.C. §112, second paragraph, as being indefinite. Claims 1, 6, 11 and 16 have been amended as shown hereinabove to recite specific hydrocarbons that are identified in the specification of the application. As a result, it is believed that these rejections are overcome.

II. The art rejections.

A. Claims 6-10 and 16-20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Rhodia Limited, GB 2,327,427 in view of Matsushita Electrical Industrial Co., Inc., EP 539,952.

Independent claim 6 (as well as dependent claims 7-10) of the present invention is directed to a refrigerant composition comprising various amounts of refrigerants R-134a, R-125 and a hydrocarbon component. The hydrocarbon component comprises one or more hydrocarbons selected from the group ("Group A") consisting of R-290, R-1270, R-170 and R-50, and one or more hydrocarbons selected from the group ("Group B") consisting of R-600a, R-600 and R-601. Each of the hydrocarbons in Group A has a boiling point lower than the boiling point of R-134a, and each of the hydrocarbons in Group B has a boiling point higher than the boiling point of R-134a. The Group A hydrocarbon and the Group B hydrocarbon in the refrigerant composition are present at a level to render the refrigerant composition nonflammable not only as originally placed in a refrigeration system, but also after about 99% of the refrigerant composition has leaked from the system.

Independent claim 16 (and dependent claims 17-20) is directed to a method for producing refrigeration using a refrigerant composition similar to that of claim 6. With respect to the refrigerant composition used in the method of claim 16, the hydrocarbon component comprises one or more hydrocarbons selected from Group A, and one or more hydrocarbons selected from Group B. In this case, the total hydrocarbon percentage does not exceed about 5 weight percent in either the liquid phase or vapor phase of the refrigerant, both as originally placed in the refrigeration system and after about 99% of the refrigerant composition has leaked from the system.

In this response to the Office Action, the Applicant, James B. Tieken, has attached his Declaration under 37 C.F.R. § 1.132. Among other things, the Applicant stated therein that the flammability of replacement refrigerant mixtures has been an ongoing concern in the refrigeration industry. A refrigerant mixture should be formulated so that it is non-flammable not only in its initial formulated condition, but also after significant leakage from the refrigeration system. The refrigerant industry has sought to minimize the use of flammable components in a refrigerant blend. However, in many CFC and HCFC replacement refrigerants that use mineral oil as a lubricating oil, it is generally necessary to add a small percentage of lower hydrocarbons to the refrigerant composition to improve the miscibility of the lubricating the oil in the refrigerant. Since hydrocarbons are flammable, the amount of hydrocarbon in the composition should be limited to an amount that does not adversely affect the flammability of the refrigerant composition.

As stated in the Declaration, the percentage of the various components that make up a refrigerant composition does not change appreciably from its original formulation during routine usage. If the refrigerant is nonflammable as formulated, then it remains so throughout normal usage. However, when a leak develops in the system, the refrigerant formulation is subject to change, since the individual components of the blend evaporate or leak from the system at different rates. This evaporation results in ever-changing percentages of the components in both the liquid and vapor phase. Thus, it is not uncommon for the percentage of hydrocarbon in either the liquid phase, or in the vapor phase, to exceed the flammability limit at some point during the leakout. When this occurs, the refrigerant composition can become flammable.

The claims of the present invention have been amended such that the formulation includes two discrete hydrocarbon portions. The first hydrocarbon portion includes specific hydrocarbon refrigerants having a boiling point lower than the boiling point of R-134a, and the second hydrocarbon portion includes specific hydrocarbon refrigerants having a boiling point higher than the boiling point of R-134a. As stated in the Declaration, by splitting the hydrocarbon component into two groups in this manner, the respective rates of evaporation of each of the hydrocarbons act to essentially cancel each other out during refrigerant leakout, and the percentage of hydrocarbon in either the vapor or the liquid phase does not exceed the flammability limit. If the hydrocarbon component was not split in this manner, then the percentage of hydrocarbon in either the vapor phase or the liquid phase (depending upon the vapor pressure of the particular hydrocarbon in the blend) would exceed the flammability level. This is shown in the Declaration, and is also shown in Example 1 provided at pages 9-11 of the present application.

The Declaration includes the results of certain computer simulation tests that were performed to compare the changes in the composition of a blend of R-125, R-134a and a hydrocarbon component throughout a leakage cycle. Simulated tests were performed on respective refrigerant compositions having a hydrocarbon component of isobutane, propane, and a combination of isobutane and propane, throughout a leakage cycle. As stated in the Declaration, when isobutane is the sole hydrocarbon, the percentage in the as formulated vapor phase is below 2%. This amount is generally considered insufficient to carry oil effectively in HFC refrigeration systems. Similarly, when propane is the sole hydrocarbon, it's percentage in the vapor phase in the as formulated state exceeds the flammability limit. When the blend of isobutane and propane is used in lower percentages, the blend does not become flammable during leakout, and there is enough hydrocarbon component in the as formulated state, and much of the leakout, to insure good oil return.

The present inventor has formulated a blend wherein even as a certain discrete portion of the hydrocarbon component evaporates into the vapor phase, another discrete portion remains with the liquid phase. This ensures that both phases maintain hydrocarbon levels at acceptable levels, not only as originally formulated, but also after significant leakage from

the system. In addition, sufficient hydrocarbon remains present in the refrigerant to maintain the miscibility of the lubricant oil in the refrigerant.

Claim 6 has been amended as illustrated above to better reflect this unique combination of hydrocarbons. Claims 8-10 are even more narrowly drawn to specify that the Group A (boiling point higher than R-134a) hydrocarbon comprises propane, and the Group B (boiling point lower than R-134a) hydrocarbon comprises isobutane. Claim 16 has been amended to reflect that the total hydrocarbon percentage does not exceed about 5 weight percent in either the liquid phase or vapor phase, both as originally placed in the refrigeration system, and after about 99% of the refrigerant composition has leaked from the system. Claims 18-20 also specify that the hydrocarbons are propane and isobutane.

According to the Examiner, the GB reference is directed to refrigerant compositions that may comprise pentafluoroethane (R-125), 1,1,1,2-tetrafluoroethane (R-134a), and butane (R-600) or isobutane (R-600a). Upon review of the reference, however, it is clear that isobutane (methyl propane) is not disclosed in the GB reference, and in fact, is expressly excluded from the disclosed composition. See, e.g. page 1, line 43, and page 2, line 37 through page 3, line 3. Isobutane is the preferred Group B hydrocarbon to be utilized in the present invention, and in fact, is the only Group B hydrocarbon recited in claims 3-5 and 18-20. Thus, since the GB reference expressly teaches away from the use of isobutane, Applicant respectfully submits that the GB citation is not an appropriate 103(a) reference, most particularly with regard to claims 8-10 and 18-20, which expressly recite isobutane as the Group B hydrocarbon in the claimed formulation.

The Examiner cited the Matsushita EP reference as teaching the combination of R-125, R-134a and R-290 (propane). According to the Examiner, it would have been obvious to substitute propane for a portion of the butane in the GB formulation. The Examiner stated, in part, that the combination would have been obvious because "The mixture of R-290 with R125 and R134a is used for the same purpose as the Rhodia mixture of R-600 or R-600a with R-125 and R134a, and it is prima facie obvious to combine two compositions to formulate a third composition to use for the same purpose."

As the Applicant has recited in his Declaration, neither of the cited references teaches or suggests a hydrocarbon component comprising a hydrocarbon having a boiling point lower

than the boiling point of R-134a, and a hydrocarbon having a boiling point higher than the boiling point of R-134a. Without the combination of hydrocarbons as claimed in Applicant's claims 6 and 16, the refrigerant blend will exceed flammability limits after leakage of refrigerant from the refrigeration system. The blends disclosed in the GB and the Matsushita references are analogous to the blends used in the comparative tests cited in the Declaration, which blends includes either about 3 wt. % isobutane, or about 3 wt. % of propane as the sole hydrocarbon component. Each of these references teaches a refrigerant blend comprising R-125 and R-134a, and a hydrocarbon component. The GB reference combines R-125 and R-134a with a hydrocarbon taken from Applicants' Group B (butane) and the Matsushita reference combines R-125 and R-134a with a hydrocarbon from Applicant's Group A (propane). As shown in Applicant's Declaration, formulations such as those taught in the cited references are flammable in either the as formulated state (propane) or after leakout, or alternatively, they do not include sufficient hydrocarbon to carry oil effectively through the refrigeration system. Thus, with either formulation, significant flammability problems remain.

Surprisingly, when splitting the hydrocarbon component between a Group A component and a Group B component according to the present invention, the blend is not flammable during leakout, and additionally, there is enough hydrocarbon component in the system to insure good oil return. As a result, Applicant's blend is clearly superior to the blends taught in either of the cited references. The only way to arrive at the Applicant's invention based upon the teachings of the two cited references is to takes bits and pieces from each of them, and add these bits and pieces until Applicant's composition is achieved. Neither the GB nor the Matsushita reference, either individually or in combination, teaches or suggests Applicant's inventive hydrocarbon combination.

B. Claims 6-10 and 16-20 were also rejected under 35 U.S.C. §103(a) as being unpatentable over Pearson, U.S. Patent No. 5,688,432.

The Pearson patent discloses a refrigerant composition comprising R-125, R-134a and a hydrocarbon selected from R-600a, R-290 and mixtures thereof. There are no working examples in the Pearson patent that describe a combination of isobutane and propane.

Similarly, Pearson neither teaches nor suggests the use of a combination of hydrocarbons having boiling points that bracket the boiling point of R-134a, and that result in a non-flammable mixture both as formulated and after significant leakage of refrigerant from the system, as claimed in amended claims 6 and 16.

It is telling that there is no discussion or recognition in Pearson of the competing concerns of providing a formulation having a sufficient hydrocarbon level to carry lubricating oil in the refrigerant throughout the system, and yet not exceed the flammability limit either as the composition is originally formulated, or after 99% of the refrigerant has leaked from the system. If such a composition can be obtained from the teaching of Pearson, it would be obtained solely as a result of guesswork and happenstance. Nothing in Pearson teaches or suggests to the skilled artisan that the hydrocarbon composition should be split into two well-defined components, each of which is present at a specified percentage to achieve the benefits of the invention.

The inventive composition strikes a careful balance between the competing concerns of flammability and miscibility that must be addressed when utilizing hydrocarbons in a refrigerant blend. The hydrocarbon component must comprise sufficient amounts of specified hydrocarbon components to accomplish these objectives. The Pearson reference is simply a general teaching of the use of hydrocarbon refrigerants, and is silent on the concept of splitting the hydrocarbon component between separate hydrocarbons in order to address important refrigerant objectives.

C. Claims 1-20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Singh, U.S. Patent No. 6,526,764 B1.

The formulations of the refrigerant compositions of claims 1-5 and 11-15 differ from claims 6-10 and 16-20 due primarily to the inclusion of R-32 in the compositions. In this amendment, claims 1-5 and 10-15 have been amended in a manner similar to the previously-described amendments to claims 6-10 and 16-20, to specify the particular hydrocarbon in each of Group A and Group B.

According to the Examiner, Singh discloses a combination comprising R-125, R-134, R-32 and a hydrocarbon component (referred to therein as a "solubilizing component"). The

hydrocarbon may be obtained from a list of possible hydrocarbons provided in Table II of Singh.

The Singh patent gives short shrift to the issue of flammability, other than noting in passing the well-known proposition that mixtures should be nonflammable as formulated. It does not provide any teaching or suggestion that a mixture that is nonflammable may become flammable after leakout of a portion of the refrigerant. Without even a recognition of the problem addressed by the present inventor, the Singh patent cannot include any suggestion to the skilled artisan for solving that problem. The only way to arrive at Applicant's claimed formulation from the Singh teaching is, again, by pure guesswork and happenstance. Nothing in Singh teaches or suggests to the skilled artisan that the hydrocarbon composition should be split into two components, each of which includes a defined hydrocarbon at a specified percentage, to maintain the nonflammability of the formulation during leakout.

D. Claims 1-20 were also rejected under 35 U.S.C. §103(a) as being unpatentable over Feiring, U.S. Patent No. 6,299,792 B1.

Feiring teaches refrigerant compositions comprising a halogenated hydrocarbon, a mineral oil or a synthetic oil, and a polymeric oil return agent. The polymeric oil return agents are said to be effective in solubilizing or dispersing mineral and synthetic lubricants with halogenated hydrocarbon refrigerant, thereby permitting efficient return of lubricants from non-compressor zones back to a compressor zone in a refrigeration system. The Feiring disclosure is unrelated to flammability concerns, and does not appear to even mention flammability in the disclosure.

Like the cited Singh reference, Feiring does not provide any teaching or suggestion that a mixture that is nonflammable as formulated may become flammable after leakout of a portion of the refrigerant. Without a recognition of the problem addressed by the present inventor, the Feiring patent cannot include any direction to the skilled artisan for solving that problem. The only way to arrive at Applicant's claimed formulation from the Feiring teaching is, once again, by pure guesswork and happenstance. Nothing in Feiring teaches or suggests to the skilled artisan that the hydrocarbon composition should be split into two components, each of which is present at a specified percentage to achieve the benefits of the

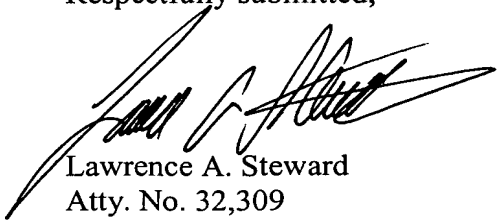
invention. It is clear that a skilled artisan seeking to address flammability issues in a proposed refrigerant formulation would not find any guidance in either the Singh or Feiring references, which are each directed to the solution of entirely separate problems.

It is noteworthy that neither Singh nor Feiring teaches or suggests the use of a combination of hydrocarbons having boiling points that bracket the boiling point of R-134a, and that result in a non-flammable mixture both as formulated and after significant leakage of refrigerant from the system, as claimed in the present claims, as amended. Although both references refer to the use of R-407B refrigerant, which includes R-32, R-125 and R-134a, and teach that a hydrocarbon (referred to as solubilizing component in Singh and an oil-return agent in Feiring) may be combined with the refrigerant for solubilizing purposes, neither teach the careful and explicit selection of specific hydrocarbons to be combined at discrete levels in a hydrocarbon component as claimed. The key concern of the present invention, namely flammability during refrigerant leakout, is essentially ignored in each of these references.

III. Conclusion

Thus, for the reasons provided above, and in view of the amendments to the claims presented herein, Applicant respectfully submits that the rejections of claims 1-20 have been overcome, and that claims 1-20 are in condition for allowance. Accordingly, Applicant respectfully requests the prompt issuance of a Notice of Allowance. If the Examiner believes that prosecution of this application can be advanced by way of a telephone conversation, the Examiner is respectfully invited to telephone the undersigned attorney.

Respectfully submitted,



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